

REMARKS

The present invention provides solid oxide fuel cells that include, *inter alia*, a solid electrolyte and a ceramic anode bonded to one another, the fuel cells being capable of directly operating on a sulfur-containing hydrocarbon fuel having two or more carbons. The disclosed fuel cells thus enable extraction of energy from such fuels without the need for costly, energy-inefficient reformation or other pre-treatment processes.

Claims 2-19, 21-30, 55, 56, 58, 60, 62-64, and 66 stand finally rejected by way of an office action dated April 10, 2009. Claims 2 (revised per claim 27), 8 (clarified per the office action's suggestion), 27 (clarified to conform to the independent claims), 29 (clarified per the office action's suggestion), 58 (canceled), and 66 (mirroring claim 64) are amended as set forth above. Neither these amendments nor new claim 68 (mirroring claim 27) present any new matter.

As set forth below, Applicants traverse the all rejections of the pending claims and submit that all of the rejections should be reconsidered and withdrawn.

I. Objection Under 37 C.F.R. § 1.75(c)

Claim 58 is objected to under 37 C.F.R. § 1.75(c) for being in improper independent form. Applicants thank the Examiner for bringing this to their attention and have canceled claim 58 as set forth above.

II. Rejections Under 35 U.S.C. § 112

Claims 8 and 29 stand rejected under 35 U.S.C. § 112 as allegedly indefinite (office action at page 3). Applicants have amended claims 8 and 29 as set forth above to provide the necessary clarification and submit that these rejections should be withdrawn.

III. Rejections Under 35 U.S.C. § 103

The pending claims stand finally rejected in view of various prior art combinations. But because these prior art combinations are improper under the MPEP and fail to address every limitation of the claimed invention, the prior art fails to make out a *prima facie* case of obviousness and the rejections should be reconsidered and withdrawn.

A. Legal Standard

To establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a), there must be a clearly articulated reason or rationale, either in the prior art itself or in the knowledge generally available to one of ordinary skill in the art, why the claimed invention is obvious in light of a reference or combined reference teachings. MPEP §§ 2143, 2143.01; *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1739-43 (2007). There must also be a reasonable expectation of success. MPEP § 2143.02. The prior art combination must address every element of the claim at issue. MPEP § 2143.03. The rationale to make the claimed combination and the reasonable expectation of success must be found in the prior art and may not be based on the applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 493 (Fed. Cir. 1991).

B. Discussion

1. The Rejections Of Claims 2, 3, 5-12, 15, 16, 18, 21, 24-30, 62, 63, And 66 Over Cable '903 In View Of Isenberg And Keegan Should be Withdrawn

The office action alleges that claims 2, 3, 5-12, 15, 16, 18, 21, 24-30, 62, 63, and 66 are obvious over Cable (U.S. Patent 5,445,903) in view of Isenberg (U.S. Patent 4,812,329) and Keegan (U.S. Patent 6,423,896) (office action at pages 3-8). Because the proposed combination of references is improper and because the combination does not suggest or otherwise address every element of the cited claims, these rejections (of independent and dependent claims) should all be withdrawn.

a. Because Cable and Isenberg Expressly Teach Away From Their Combination, The Cable-Isenberg Combination Is Improper and Cannot Support the Obviousness Rejection

The office action suggests that Cable and Isenberg may be combined to arrive at the claimed invention (office action at pages 3-6). But because these references teach away from combination with one another **and** away from the claimed invention, the proposed combination is improper under the MPEP and as a matter of controlling Federal Circuit law. *See* MPEP § 2145.X.D.2 (references that teach away from their combination cannot be combined to support obviousness rejection); *see also Ecolochem, Inc. v. Southern Cal. Edison Co.*, 227 F.3d 1361, 1373-75 (Fed. Cir. 2000) (reversing district court's finding of obviousness where cited references taught away from their combination). Accordingly, the

Cable-Isenberg combination cannot support the proposed obviousness rejections, and the rejections should be reconsidered and withdrawn.

A careful review of Cable and Isenberg first makes clear that the cited references teach away from combination with one another. The Background section of Cable ‘903 expressly criticizes the electrodes described by Isenberg in US Patent 4,582,766, noting that in devices made according to Isenberg, the electrolyte is bound to the electrode, which bonding results in undesirable mechanical and structural complications (*see* Cable ‘903 at col. 2, lines 38-41). The Cable reference then states that the shortcomings of the Isenberg invention may be overcome by **avoiding** bonding between the electrode and electrolyte, which may be accomplished through positioning an element between the electrode and the electrolyte (Cable ‘903 at col. 2, lines 46-52).

Like the Isenberg ‘766 patent, the Isenberg ‘329 patent cited by the pending office action similarly describes electrodes that are bonded to an electrolyte (*see* Isenberg ‘329 patent at, *e.g.*, **FIG. 1**). The Cable ‘903 reference, however, states that such electrode-electrolyte bonding is to be avoided, noting that the “[t]he problems of ceramic-metal mismatch are not solved, **and are indeed increased by the electrolyte/electrode bonded structure**” (Cable ‘903 at col. 2, lines 38-41) (emphasis added). Thus, because Cable expressly warns against Isenberg’s approach, the references teach away from their combination and the combination is improper under the MPEP and as a matter of controlling Federal Circuit law. *See* MPEP § 2145.X.D.2 (references that teach away from their combination cannot be combined to support obviousness rejection); *Ecolochem*, 227 F.3d at 1373-75 (reversing district court’s finding of obviousness where cited references taught away from their combination); *In re Grasselli*, 713 F.2d 731, 743 (Fed. Cir. 1983) (references that taught away from their combination cannot be combined to support obviousness rejection). Accordingly, all rejections (of both independent and dependent claims) under the Cable-Isenberg-Keegan combination should be reconsidered and withdrawn. MPEP § 2145.X.D.2.

b. Because Cable and Isenberg Expressly Teach Away From The Claimed Invention, the Cable-Isenberg Combination Is Improper and Cannot Support the Obviousness Rejection

In addition to teaching away from their combination, the cited references also teach away from the claimed invention. Governing Federal Circuit law is clear that references that teach away from the claimed invention cannot support an obviousness rejection. *See W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1550 (Fed. Cir.) (reversing district court's finding of obviousness where district court erred by "disregarding disclosures in the references that diverge from and **teach away from the invention at hand**") (emphasis added), *cert. denied*, 469 U.S. 851 (1984); *see also* MPEP § 2141.02.VI.

Despite this clear guidance from the Federal Circuit, the office action nonetheless combines references that teach away from one another **and** from the claimed invention. While the claimed invention recites that the anode and electrolyte are bound to one another, the cited Cable '903 reference – as explained above – expressly criticizes such bonding and instead advocates the disposition of so-called "microslip zones" between the electrolyte and the electrode components (Cable '903 at col. 5, lines 53-68). Because the law is clear that a reference does not render a claimed invention obvious when the reference itself teaches away from the claimed invention, *see* MPEP § 2145.X.D.2, the proposed combination cannot support the proposed rejection, and all rejections (of independent and dependent claims) should be withdrawn.

c. The Office Action's Suggestion That Cable '903 Teaches Electrodes And Anodes Bound To One Another Misreads The Reference and is Impermissibly Speculative

In response to Applicants' observation that Cable expressly criticizes and teaches away from Isenberg's bonded electrode-electrolyte approach, the office action suggests that Cable discloses anodes and electrolytes that are bound to one another. The Cable reference does not, however, support this position.

More specifically, the office action suggests (at least twice) that the Cable '903 reference teaches bonding between an electrode and an electrolyte:

“As seen in fig. 1 [of Cable ‘903] , the solid electrolyte and the anode [4] are placed next to one another (overlap), in physical contact (**and are thus bound to one another**)” (office action at page 5) (emphasis added)

“Fig. 1, which is embodied by Cable ‘903, shows **direct bonding between the anode and the electrolyte** as well” (office action at page 23 (emphasis added)

This interpretation of the reference is incorrect. Applicants agree that Fig. 1 of the Cable ‘903 reference shows an anode and an electrolyte **next to** one another. But nowhere does the Cable ‘903 reference go on to state that the anode and electrolyte are also **bound to** one another, and the MPEP and controlling Federal Circuit law are clear that a reference may **not** be interpreted to include a feature that **might** be present. As MPEP § 2112 explains, “the mere fact that a certain characteristic or result **may** occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic.” Similarly, the Federal Circuit has explained that a reference may not be interpreted to include a feature that merely **could** be present: “The mere fact that a certain thing **may result** from a given set of circumstances **is not sufficient**.” *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999) (emphasis added); *see also Perricone v. Medicis Pharm. Corp.*, 432 F.3d 1368, 1379 (Fed. Cir. 2005) (rejection improper where rejection “assume[d] what [the prior art] neither disclosed nor rendered inherent”).

In the present case, the Cable ‘903 reference shows only an anode and electrode next to one another. The reference contains no support for the further conclusion that anode and electrolyte are also bound to one another. *See In re Robertson*, 169 F.3d at 745 (that a certain feature “may result” is insufficient to support rejection); *see also* MPEP § 2112. Accordingly, the office action’s position that Cable ‘903 teaches bonded electrode-electrolyte assemblies is misplaced because the reference does not in fact support that position.

The office action’s suggestion that Cable ‘903 teaches bonded anode-electrolyte assemblies is also contrary to the stated goal of the reference. As previously discussed, the stated goal of the Cable ‘903 reference is to **avoid** the problems associated with bonding the anode to the electrolyte (Cable ‘903 at col. 2, lines 38-41). Applicants respectfully suggest that it is improper for the office action to read the Cable ‘903 reference as not teaching away from bonded anode-electrolyte assemblies where the reference in fact **expressly criticizes**

such assemblies. Accordingly, the office action's suggestion that Cable '903 can be combined with Isenberg is contrary to the express goals of the reference.

d. The Office Action's Suggestion That The References Can Be Combined Fails To Explain Why One Of Ordinary Skill In The Art Would Disregard The References' Express Teaching Away

The office action also suggests, at various places, that Cable and Isenberg can be combined because the two references are being used to address sulfur tolerance and that one of skill in the art could accordingly disregard the references' teaching away (office action at, e.g., page 23, 28). Applicants respectfully disagree on the ground that the pending claims require that the anode be bound to the electrolyte, and the office action does not explain why one of ordinary skill in the art would disregard a teaching away that goes directly to a limitation of the pending claims.

Federal Circuit law is clear that an office action's assessment of what is known in the art must be based on citation to record evidence, not on mere speculation. *See In re Zurko*, 258 F.3d 1379, 1385 (Fed. Cir. 2001) (assessment of what is known in the art must be based on citation to record evidence). In the present case, however, the office action – without explanation or citation to record evidence – asserts that one of skill in the art would overlook the teaching away in Cable '903 to arrive at the claimed bound electrode-electrolyte assemblies (office action at page 36). But because the office action cites no record evidence to explain precisely why one of skill in the art would disregard this teaching away, the office action's position lacks the necessary factual foundation. *Id.*; *see also W.L. Gore*, 721 F.2d at 1552 (reversing obviousness rejection where district court failed to explain why those skilled in the art would have disregarded teaching away contained in cited references). Because the office action provides no evidence to support its conclusion that one of skill in the art would disregard a teaching away that goes directly to a limitation of the pending claims, the office action's position lacks a proper basis. Accordingly, the pending rejections should be reconsidered and withdrawn.

e. The Rejections Under the Cable-Isenberg-Keegan Combination Should be Withdrawn Because the Combination Fails to Address Every Claim Limitation

Even if the Cable-Isenberg combination were proper – and Applicants do not concede this – the addition of Keegan (U.S. Pat. 6,423,896) nevertheless fails to address every element of the pending claims. Accordingly, the combination cannot support the proposed obviousness rejection. *See* MPEP § 2143.03.

More specifically, the pending claims recite, *inter alia*, direct operation on hydrocarbon fuels that have two or more carbons and that do not undergo prior treatment to remove organic sulfur compounds. The office action concedes that neither Cable ‘903 nor Isenberg, singly or in combination, teaches this limitation of the pending claims, and relies on Keegan to cure the other references’ deficiencies (office action at pages 5-7).

Keegan, however, does not cure these deficiencies because the reference does not describe fuel cells capable of directly operating on hydrocarbons that do not undergo prior treatment. A review of Keegan and a comparison with the pending claims makes this clear.

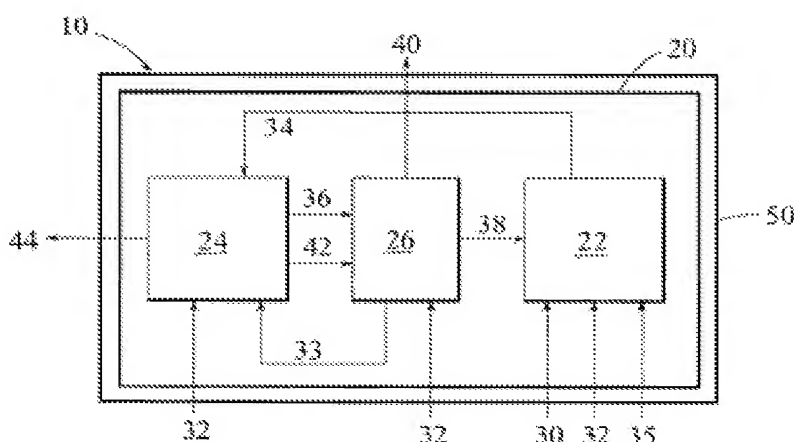
The pending claims recite devices “capable of directly operating with a sulfur-containing hydrocarbon fuel that does not undergo prior treatment.” Keegan, however, provides no such teaching. Although Keegan discusses some fuels, Keegan also expressly states that such fuels must undergo reformation or other prior treatment) **before** the fuel cell operates on the fuel:

“Located within the fuel cell system enclosure 20, **is the reformer system 22** that comprises a main reformer, and optionally, a micro-reformer. The reformer 22 is provided with a fuel through a fuel inlet 30, an exterior air (or oxidant) inlet 32 , and a water supply inlet 35 . The reformer system 22 is thermally isolated from the fuel cell stack 24 , (i.e., a segmented enclosure, isolated enclosure, or the like). **The processing or reforming of hydrocarbon fuels, such as gasoline, is completed to provide an immediate fuel source for rapid start up of the fuel cell as well as protecting the fuel cell by removing impurities. The reformer system 22 , preferably utilizing a steam reformer, creates a reformat 34 for use by the fuel cell stack 24.**” (Keegan at col. 2, line 66 – col. 3, line 15) (emphasis added)

“During operation of the fuel cell system, a hydrocarbon fuel is directed to a reformer where the fuel is processed into a reformat for use by the fuel cell stack. The fuel cell stack uses the reformat to create electrical energy for harnessing, as well as producing thermal energy as a byproduct.” (Keegan at col. 4, line 65 – col. 5, line 2) (emphasis added)

Fig. 1 of Keegan further emphasizes that the reference teaches that fuels must be reformed before they are processed by a fuel cell. In that figure (reproduced below for ease of reference), the fuel enters the device only by way of inlet 30, after which it is processed by the reformer 22 (see Keegan at col. 2, line 66 – col. 3, line 4). Only after the fuel is processed/reformed does the processed fuel enter the fuel cell stack 24.

FIG. 1



Thus, Keegan teaches only that hydrocarbon fuels – including those having two or more carbons – must be reformed or pre-treated before they are used by a fuel cell. By contrast (and as set forth in additional detail in Applicants’ August 9, 2007 Submission), the claimed devices are capable of using fuels that **do not** undergo pretreatment, which is qualitatively different than what Keegan describes.

Accordingly, because Keegan’s reformation requirement (1) expressly teaches away from the claimed invention; and (2) fails to address the claimed invention’s limitation of direct operation on hydrocarbon fuels, the addition of Keegan cannot cure the acknowledged shortcomings of the Cable and Isenberg references. Because the Cable-Isenberg-Keegan

does not make out a *prima facie* case of obviousness, all rejections based on that combination should be reconsidered and withdrawn.

* * * * *

In sum, because the proposed reference combination cannot support a *prima facie* case of obviousness, the pending rejections should be withdrawn. First, the Cable-Isenberg combination is improper because (1) the references teach away from their combination; (2) the references teach away from the claimed invention; (3) the office action misreads the Cable '903 reference; and (4) the office action provides no citation to record evidence to support the position that one of skill in the art would disregard this teaching away. Second, while the office action alleges that Keegan addresses the claim limitations regarding direct operation with hydrocarbon fuels, a review of Keegan reveals that the reference discloses only that fuel cells must operate on pre-treated or reformed fuels, **not** that fuel cells engage in direct operation on fuels. Accordingly, the Cable-Isenberg-Keegan combination cannot support an obviousness rejection, and all rejections based on that combination should be reconsidered and withdrawn.

2. The Rejections Of Claims 4, 13, 14, And 23 Over Cable '903 In View Of Isenberg and Keegan, As Applied To Claims 62, 10-12, 63, and 22 in Further View of Anumakonda Should Be Withdrawn

The office action alleges that claims 4, 13, 14, and 23 are obvious over Cable '903 in view of Isenberg and Keegan, as applied to claims 62, 10-12, 63, and 22, and in further view of Anumakonda (U.S. Pat. 6,221,280). For the reasons described above, all of these rejections should be reconsidered and withdrawn; Applicants note that Anumakonda – akin to Keegan – recites reformation of sulfur-containing fuels to hydrogen and carbon monoxide **before** the fuel cell operates on the fuels (Anumakonda at, *e.g.*, col. 7, lines 40-44, col. 8, lines 30-48).

3. The Rejections Of Claims 17 and 19 Over Cable '903 In View Of Isenberg And Keegan, As Applied To Claims 62, 15, and 16, in Further View of Wallin Should Be Withdrawn

The office action alleges that claims 17 and 19 are obvious over Cable '903 in view of Isenberg and Keegan, as applied to claims 62, 15, and 16, and in further view of Wallin (U.S. Pat. 6,017,647). For the reasons described above, all of these rejections should be

reconsidered and withdrawn; Applicants note that Wallin does not cure the deficiencies of Cable, Isenberg, or Keegan (singly or in combination).

4. The Rejections Of Claims 55, 56, and 60 Over Cable ‘903 In View Of Isenberg And Keegan, As Applied To Claims 62, 63, 65, and 66, in Further View of Cable ‘285 Should Be Withdrawn

The office action alleges that claims 55, 56, and 60 are obvious over Cable ‘903 in view of Isenberg and Keegan, as applied to claims 62, 63, 65, and 66, in further view of Cable (U.S. Pat. 5,589,285). For the reasons set forth above, all of these rejections should be reconsidered and withdrawn; Cable ‘285 does not cure the deficiencies of Cable, Isenberg, or Keegan (singly or in combination).

5. The Rejections Of Claims 58 and 64 Over Cable ‘903 In View Of Isenberg And Keegan, As Applied To Claims 62, 63, 65, and 66, in Further View of Cable ‘285 Should Be Withdrawn

The office action alleges that claims 58 and 64 are obvious over Cable ‘903 in view of Isenberg and Keegan, as applied to claims 62, 63, 65, and 66, in further view of Cable ‘285. For the reasons set forth above, all of these rejections should be reconsidered and withdrawn.

III. CONCLUSION

For all of the foregoing reasons, Applicants submit that the objection under 37 C.F.R. § 1.75(c) and the rejections of certain claims under 35 U.S.C. §§ 103(a) and 112 should all be reconsidered and withdrawn.

First, the pending rejections are first improper because the primary references on which the office action relies – Cable and Isenberg – teach away from their combination **and** away from the claimed invention. References that contain such a teaching away cannot, however, support a *prima facie* case of obviousness. In any event, even if the Cable-Isenberg combination were proper (which Applicants do not concede), the addition of the Keegan reference to cure the admitted shortcomings of the Cable-Isenberg combination does not make out a *prima facie* case of obviousness because Keegan does not address the claimed fuel cells that operate with fuels that do not themselves undergo pretreatment.

Accordingly, Applicants respectfully request that the office (1) enter the requested amendments to the claims; (2) reconsider and withdraw the pending objections and rejections; and (3) pass the pending claims to allowance.

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**PATENT
REPLY FILED PURSUANT
TO 37 CFR § 1.111**

If the examiner believes that additional communication will expedite prosecution of this application, the examiner is invited to telephone the undersigned at the number provided.

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